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REMARKS

Applicants wish to thank the Examiner for the benefit of the interview on November 20, 2003. The interview allowed applicants' counsel to explain the presently claimed invention and how it distinguishes from the prior art. The interview was also beneficial in understanding that the concern of the Examiner was distinguishing the claimed subject matter from Japanese Patent Publication JP 59215257A. A translation of this reference has been submitted. Applicants note that JP '257 was earlier work by the same project that produced the present invention; indeed, one of the inventors, Hisahiko Fukase is common to both the presently claimed subject matter and JP '257.

As explained at the interview, JP '257 and the presently claimed subject matter are both directed to methods of startup of a twin roll caster without the use of a dummy bar. However, there the similarities stop. the presently claimed subject matter is describing a method quite different to that disclosed by JP '257.

Prior to JP '257, in twin roll casters, a dummy bar formed of an asbestos or an insulating material was inserted into the roll gap between the casting rolls to allow formation of the casting pool of molten metal on the casting rolls above the nip, and then the casting of the strip started by rotating the casting rolls allowing the dummy bar to lead the strip through the nip of the casting rolls. The problem with use of the dummy bar was that each time a cast was started, a new dummy bar had to be inserted and a new casting pool formed, at great loss of time and expense.

JP '257 proposed a method of formation of a casting pool without a dummy bar, but not cast strip initially of any desired thickness. This method was found to be unworkable. JP '257 instructs that the thickness of the strip to be cast is directly dependent upon the velocity of the peripheral surfaces of the casting rolls, and follows the equation $t = K \cdot V^{-0.5}$ where "K as a constant which varies according to the steel type and the temperature conditions, but is generally within the zone from 8 to 10 in the case of 500 mm ϕ twin rolls". Translation at 3. Accordingly, teaches JP' 257, there is an "ideal state of the zone of approximately ± 10% in the zone Z in which the metal can be cast" and "there is an upper C for the strip gauge t and the roll gauge G at which a dummy bar is not required, within the zone Z within which metal strip can be cast." *Id.*

Stated simply, according to JP '257, the thickness of strip that can be cast without dummy bar is directly dependent upon the velocity of the peripheral surface of the casting rolls and the constant K which itself varies according to the steel type and the temperature conditions. JP '257 goes on to explain that by starting with a roll velocity V for

example, 20 meters per minute for a strip gauge 2 mm, the roll velocity V can be gradually decreased[1] to, for example, 10 meters per minute and the roll gap G can be gradually widened to a desired thickness, for example 4 mm. Thus, JP '257 teaches that the velocity and strip thickness must be selected to permit formation of the casting pool without a dummy bar, and then later gradually varied in a coordinates operation to cast strip of a desired thickness without the use of a dummy bar. The problem is that the "constant" K is not actually a constant since it varies not only with steel type but with temperature conditions of the molten steel in the casting pool. This means that even the starting velocity V for casting varies. Further, the relationship is not reliable. In addition, even if the proposal were workable, the problem in the method of JP '257 is that there is a substantial waste of a cast strip and corresponding time and money at startup without the use of a dummy bar.

In JP '257, **casting** at the outset starts with a gap that is less than the desired strip thickness for the cast strip. **That gap is the same as the gap that allows formation of the casting pool.** That is, the initial gap to form the casting pool also is determines the initial cast strip thickness in the JP '257 method. **The speed of rotation of the casting rolls is also determined by the initially set gap using the relationship $t = K \cdot V^{-0.5}$.** The gap is thereafter gradually widened **after initial casting as the velocity of the casting surfaces of the casting rolls are gradually reduced following the relationship $t = K \cdot V^{-0.5}$.**

By contrast in the presently claimed method, the casting of the strip at the outset of casting is to a thickness greater than the initial gap setting by the casting rolls moving laterally away from the other casting roll against the continuous biasing to increase the gap between the casting rolls to accommodate the desired thickness of the strip to be cast. Indeed, the gap may be increased to initially form strip of a thicknesses greater than the desired thickness before steady state casting is reached. In any case, the initial speed of rotation of the casting rolls at the outset of casting, when the casting pool is formed, is also determined to accommodate the desired thickness of the strip to be cast, rather than at a speed to accommodate casting of strip of the thicknesses of the initial gap setting between the casting rolls -- the same gap to allow formation of the casting pool without a dummy bar as described in JP '257. The gap between the casting rolls and in turn the thickness of the cast strip at the outset of casting is determined by the pool height and the speed of rotation of the casting rolls acting against the continuous biasing.

1 The text of the translation inaccurately says "increased." The rest of the description and Figure 2 shows that the roll velocity is decreased.

Stated simply, in the presently claimed subject matter the gap between the casting rolls is allowed to increase at the outset of casting by the casting rolls moving against the continuous biasing to increase the gap to cast at a thickness at least as great as the desired thickness. Preferably, the thickness of the cast strip is greater than the desired thickness until the desired casting pool height is reached, and then the casting speed further increased to narrow the gap slightly to reach the desired thickness. Those casting conditions then continue during the casting of strip at the desired thickness controlled by the height of the casting pool and speed of rotation of the casting rolls. As noted, to accommodate steady state conditions at the desired thickness, the rotation speed of the casting rolls may also be increased or otherwise adjusted during the campaign; however, there is no gradual increase of the gap after casting is started with gradual and corresponding controlled decrease in roll velocity as taught by JP '257 to reach a desired strip thickness.

To understand the differences between the presented claimed invention and the disclosure in JP '257, the thicknesses of the cast strip in relation to the speeds of rotation of that casting rolls need to consider at three different time frames: (i) before casting has started, (ii) at the outset of casting, and (iii) when the desired thicknesses of the strip to be cast has been reached. Before casting has begun, both the presently claimed subject matter and the JP' 257 method have a gap between the casting rolls less than the gap for casting strip of the desired thickness to allow formation of the casting pool without a dummy bar, but in the presently claimed subject matter the speed of rotation of the casting rolls is to accommodate the desired thicknesses of the cast strip while in the JP' 257 method the speed of rotation of the casting rolls is set to accommodate casting of strip at the thickness of the initially set gap. At the outset of casting, in the claimed invention the gap between the casting rolls is greater than the initially set gap and the speed of rotation of the casting rolls is set to accommodate the desired thickness of the cast strip, while in the JP '257 method the gap between the casting rolls is the same as the initially set gap and speed of rotation of the casting rolls is set to cast strip at the thickness of the initially set gap. Finally, casting at the desired thickness in the present claimed invention casting is reached very rapidly after the outset of casting with the gap between the casting rolls and the speed of rotation of the casting rolls being such as to accommodate casting at the desired thickness from the outset (with only intermittent adjustment of the speed of rotation to achieve the desired pool height), while in the JP '257 method the desired thickness of the cast strip is reach only gradually as the gap between the casting rolls is increased and the speed of rotation of the casting roll is corresponding decreased according to the relationship $t = K \cdot V^{-0.5}$.

Therefore, JP '257 does not render obvious the presently claimed subject matter. To the contrary, the teaching of JP '257 in a direction opposite from the presently claimed subject matter to achieve start up without a dummy bar and evidences non-obviousness of the presently claimed subject matter. Specifically, as set forth in Claim 1 of the claimed invention (i) the cast strip at the outset of casting is greater in thickness than the initial gap setting before casting -- not the same thicknesses as the gap set to form the casting pool as described in JP '257; and (ii) the speed of rotation of the casting roll is at the outset of casting to accommodate the desired thickness of the strip to be cast -- not set to correspond to cast strip at a thicknesses corresponding to the initial gap setting between the casting rolls before casting to enable formation of the casting pool without a dummy bar as described in JP '257.

Applicants understand from the interview that the Examiner's concern is the stated purpose in the translation abstract of JP '257:

> "PURPOSE: To permit easy startup of continuous casting for a thick steel strip by starting casting at a small roll gap in the stage of starting charging of a molten metal with a twin roll type continuous casting machine then increasing gradually to the roll gap."

The inherent inaccuracies of translation for Japanese to English aside, this stated purpose should not be read out of context of the disclosure of the reference. Specifically, the abstract is "starting casting at a small roll gap" and "then increasing gradually the roll gap" with a specified reduction in roll velocity to reach the desired cast strip thickness. As JP '257 teaches, the gradual increase in roll gap is directly dependent upon the decrease in velocity and the value of the "constant" K which varies with steel type and temperature conditions.

To the contrary, with the presently claimed method the desired thickness is reached at the outset of casting by allowing the gap to increase with the strip forces acting against the biasing of the casting rolls.

The other cited references JP 55-165260 and EP 903190 are remote prior art dealing with entirely different problems. JP '260 addresses the making of cast strip formed not more than 1 mm thick, and addresses in that context, the problem of uniform shape and cracks in surface structure due to the localized expansion of the casting rolls. The casting rolls are provided with angular grooves in the form of, for example, recessed ellipses varying according to the temperature of the molten steel and the gauge of the strip, and preferably between 0.03 mm and 0.2 mm more preferably between 0.05 mm and 0.1 mm. See Translation at 6. Firstly, this configuration of the casting rolls affects the localized reduction

due to the expansion of the rolls, and secondly, the increase in temperature at center portion of the width of the strip where cracking readily develops when the molten metal passes through the gap between the rolls. The configuration of the casting rolls described in JP '290 serves to prevent the development of cracking in the thinner strip. *Id.* JP '290 does not address the problems of startup in anyway, with or without dummy bar. To the contrary, the thickness of the strip is set by the gap between the casting rolls and the gap is not changed except when a different thickness of strip is desired to be cast.

Similarly, EP '190 addresses a totally different problem. EP '190 provides for casting roll modules in the form of a cassette which can be readily moved into operative position in the caster, but also can be readily removed when the casting rolls are to be replaced. One roll is continuously biased laterally toward the other casting roll by application of biasing forces to the removable roll carriers, and a stop is used to set both the removable roll carriers. The first Official Action acknowledges that EP '190 "fails to teach setting in initial gap between the rolls at the nip which is less than the thickness of the strip to be cast, and then increasing the gap between the rolls to accommodate the thickness of the initial cast strip." First Official Action at 4. Accordingly, EP '190 admittedly does not address the deficiencies of JP '257 in failing to disclose or suggest the presently claimed subject matter. Indeed the obviousness rejection based upon EP '190 and JP '257 in combination is resolved by an understanding of JP '257 and how it distinguishes from the presently claimed subject matter is described above.

As for the double patent rejection based upon U.S. Patent No. 6,397,924 in view of JP '260, that is addressed in the Amendment filed on August 13, 2003. The same analysis applies to the presently presented claims.

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Applicants respectfully submit that claim 1 through 23 as presented here are in condition for allowance, and should be allowed. If the Examiner has any further questions, applicants respectfully request that he telephone applicants' counsel at 317-231-7390.

Respectfully,

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